PB-213 961

RECYCLING ASSESSMENT AND PROSPECTS FOR SUCCESS

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Environmental Protection Agency
Cincinnati, Ohio

1972

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National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
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RECYCLING

Assessment & Prospects for Success

by ARSEN DARNAY

Philosophical Perspectives

Our Relationship to Nature. Since the 19th century, Western man has exhibited a strangely ambiguous attitude toward nature—anxious to imitate her ways and to unravel her mysteries, eager at the same time to reap her fruits and to exploit her resources. This polarity of attitude is still with us: on the one hand advertising messages tell us how this or that product improves upon nature's way of doing things; on the other hand our maladaptation to the natural environment that feeds and shelters us is proclaimed by a rising chorus of voices.

We Are Maladapted. Today those who tell us that we are maladapted to nature and those who question the fitness to survive of our industrial society are still a minority. The orthodox religion of our day—believed in by millions—is that science and technology are capable of improving upon nature and of removing the adverse effects of past industrial practices. It is still largely heresy to insist that what's wrong with our way of life is not this or that specific problem—like solid waste mismanagement or urban decay—but a fundamental maladaptation to the long-range requirements of survival on this planet. Yet, as the consequences of our highly industrialized, chemicalized, urbanized, and congested way of life become more and more obvious and more and more threatening, so does our awareness grow that something fundamental is wrong and that 19th-century man, who set in motion the industrialization of

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Since earliest history the circle, in Nature and of man's devising, has symbolized renewal or recycling. The illustrations in this publication, drawn from both sources, are intended to reflect that process.

the world, had reason enough to feel a vague anxiety about nature and her ways.

Is there really cause for concern? Are we really maladapted? Are we poisoning ourselves? Are we running out of resources? I believe the answer is definitely *yes* to all of these questions. What is surprising to me is that so few realize what the implications of our current modes of behavior are. Nature is built around a balance of forces. Rabbits and foxes keep each other in balance. All the rivers flow into the sea, yet the sea is not full, as the Preacher says in *Ecclesiastes*. All is balance; cause is followed by effect, and each effect becomes a cause, so that survival is possible. Every waste product is a food source; every chemical substance formed by nature has a corresponding substance designed to break it down. Every expenditure must be paid for; every infraction of the rules is followed by appropriate consequences.

If you examine the life patterns of the industrialized world, especially those of the United States, you see patterns that spell imbalance. We are far out on a limb, but we are unaware of it. Our total consumption of energy in 1968 was equivalent to 11 tons of coal for every man, every woman, and every child. Our population is increasing at a rate of about 1.5 percent yearly, yet our consumption of products grows between 4 and 6 percent a year. Approximately 200 million tons of paper, iron, steel, glass, nonferrous metals, textiles, rubber, and plas-

tics flow through the economy yearly, and materials weighing roughly the same leave the economy again as waste.

This is a situation of imbalance and maladaptation. Most of the energy and many of the materials we use are derived from nonrenewable deposits: we are consuming our *capital,* rather than our earnings.

The Myth of the Perpetual Motion Machine. Why aren't we more worried about this situation? Throughout history man has dreamed of getting something for nothing. While this is impossible, of course, the dream is persistent, taking ever new forms. In medieval times people tried to build perpetual motion machines. We have our equivalent dream. We believe in the infinite potential of science and technology to get us out of the fix we are in. Nuclear power will get us out of the box, we believe, and later fusion power will give us unlimited energy. So why worry? The fact is that everything has a cost, perpetual motion machines don't work, and science will not allow us to transcend the laws of nature; the job of science is to help us understand those laws.

The Need for New Adaptations and the Role of Resource Recovery. Today we know enough to know that the royal orgy of industrialization will be followed by a guilty and sober morning-after of general reassessment and—ultimately—change. We must adopt a new attitude toward nature. We must find our way back to the Middle Path where the potential for survival is greatest.

Recycling or resource recovery is but a small part of a gen-

eral program to get back off the limb we are on. Moreover, it is an interim step in that program. As far as resources are concerned, the ultimate aim must be reduction of our consumption. But as we retrace our steps, the first step can and should be to use again the materials we have already used.

Recycling Today

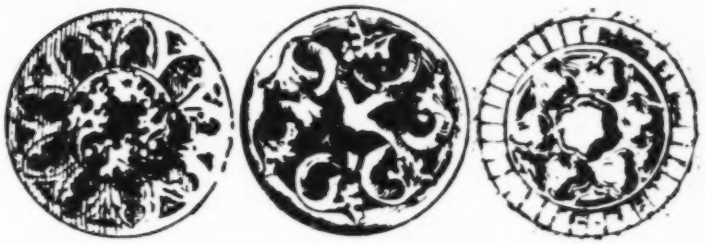
The Materials Cycle. Where do we in the United States stand today so far as resource recovery is concerned? Every year we consume roughly 190 million tons of major metals, paper, glass, rubber, and textiles. Of this consumption, 48 million tons are satisfied from recycling operations, and 142 million tons come from virgin resources. Thus the recycling rate for those materials we *do* recycle is 25 percent of consumption. It is important to realize that most of the materials recycled come from industrial processing, fabrication, and manufacturing operations rather than from obsolete products. These are wastes that occur in relatively *pure* form and are not contaminated and mixed with materials undesirable to the waste buyer.

In addition to the materials suitable for recycling, large tonnages of other substances are consumed that pass through the economy without recovery. For example, food products are consumed; the wastes are processed into sludges that nobody wants—not because these sludges are without value but because they can't compete with cheap synthetic fertilizers in the agricultural market. Fly ash from utilities and slags from certain metallurgical operations are also good plant nutrients but have no markets. In this perspective, a 25 percent recycling rate for a selected grouping of materials is no cause for rejoicing.

Proportionately to consumption, resource recovery has been steadily losing ground in virtually every materials sector. Considering all aspects of materials-use—technical, locational, economic, and product-quality-related aspects—it is more desirable today to use virgin natural resources than secondary materials derived from waste. We import raw materials across thousands of miles of ocean and use them within a few miles of places where those same resources, in already processed form, are being dumped or landfilled. Clearly, industrial materials-

use decisions do not take into account a number of factors that should correct this situation.

There are no economic or technical events on the horizon that would indicate a reversal of this trend. The economic system, if allowed to continue to operate as it does, will continue to select virgin raw materials in preference to wastes. This fact should be etched into the awareness of those who look to recycling as a way out of the solid waste management dilemma. At the same time, there are public initiatives on the horizon to breathe new life into resource recovery.



Resource Recovery, Pollution, and Energy Use. While the current situation is not encouraging, information is emerging slowly to show that resource recovery is a beneficial activity for more than one reason: if two production systems are compared, one using virgin materials, the other secondary materials, the system using wastes causes less air and water pollution, generates less solid waste, and consumes less energy. This is true if the environmental impacts of all activities in a system are measured—mining, processing, fabrication, manufacturing, and disposal and transportation steps between these. For a waste material, collection of the waste is equivalent to mining, and recovery of the waste is equivalent to disposal. If the costs of the environmental impacts and energy-use associated with virgin materials-use were reflected in production costs, there would be more recycling. But we are yet counting those costs.

A base of evidence is thus being constructed to show that there is an excellent justification for resource recovery. The job now is to ensure that the economy begins to reflect the beneficial nature of recycling by using more secondary materials.

There are basically two current approaches to bringing this about: one relies on technological means, the other on incentives.

Resource Recovery Technology. The technological approach is based on the assumption that the reason for our declining recycling rate is the inaccessibility of secondary resources. Technology is needed, the argument runs, to make wastes available to industry or agriculture. If only we could get the paper or glass out of the waste, industry would gladly receive it.

This argument is partially sound. We do need to make waste commodities accessible. But creating a supply will not ensure a demand. Technology is only part of the solution, and not even an absolutely necessary part.

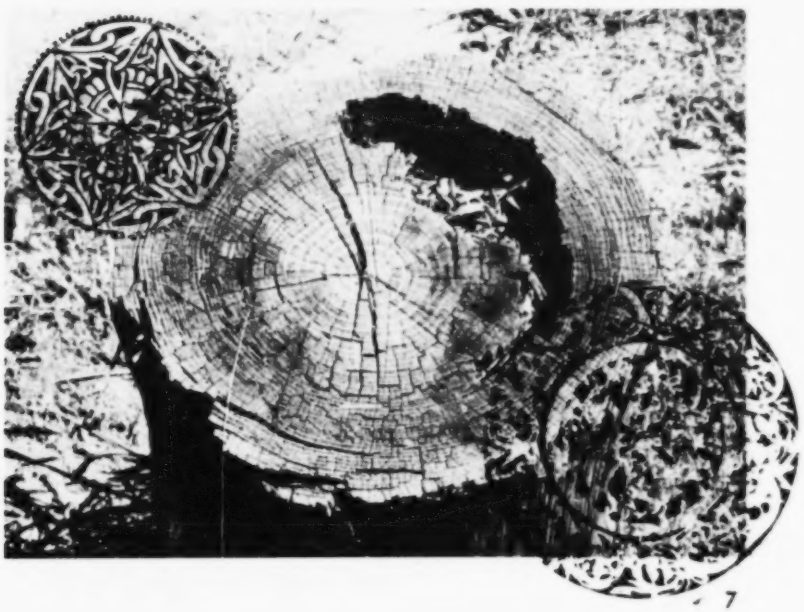
Studies conducted with U.S. Environmental Protection Agency (EPA) support and the experience gained in a number of demonstration programs show that there are no markets for certain commodities, and making them simply results in pouring dollars into useless products still needing disposal. The costs of technological waste processing are high. Regardless of the technology used—dry or wet sorting, pyrolysis, heat recovery after combustion, composting, or other systems—at a daily capacity range of 500 tons per day, the system will cost more to operate than it will realize in income. Net costs, the remainder after revenues are deducted from operating costs, are likely to range from $2.80 to $6.30 per ton. This kind of cost per ton exceeds disposal costs in all but the most hard-hit communities. Given the chronic fiscal problems of cities, do you suppose that the decision to subsidize a resource recovery system will be easy?

The costs cited are related to the prices currently paid for waste materials. If these prices were to rise, resource recovery economics would improve. Similarly, if disposal costs were to rise, recycling, even at current price levels for commodities, would be easier to justify.

The economic data cited are not the final word. These data are derived in many instances from estimates, extrapolations of information obtained from pilot-plant operations, and assump-

tions that a plant's total product output can actually be sold. Since making these early studies, we are now obtaining scattered evidence that capital and operating costs may in some instances be higher than originally estimated. At the same time, there is the hope that resource recovery techniques will be perfected and will mature, and as they do mature that their economics will become more attractive. Today there is no comprehensive recycling system in existence in this country operating on mixed municipal wastes that has a capacity range of several hundred tons a day; thus every report on recycling techniques is provisional .

Resource Recovery Incentives. However marvelous the machinery is, the real test of resource recovery is the sale of the product of the machine. In the past several years, there have been hopeful stirrings in industry, indicating at least a willingness to accept waste products back. So far there is only willingness to accept, not yet a concerted industrial drive to seek out, waste resources. The only incentive for most industrial sectors to recycle wastes is negative—the fear that legislation will be passed taxing or banning various materials or packages. To avoid this threat, and also to show a genuine desire to help



solve social problems, industry has been willing to take back the very small tonnages of wastes recovered in neighborhood recycling centers and scattered, small urban waste recycling operations. In some instances, the use of such resources by industry is suspected to be uneconomical.

Before resource recovery becomes viable on a large scale, incentives for industrial use of waste materials must become much greater. This means that secondary materials must become cheaper than equivalent virgin resources or that virgin resources must become more expensive relative to raw materials derived from wastes.

Providing secondary materials at lower cost is not likely to be achieved by technological means, as I have indicated. Even if recycling technology makes giant strides forward, it is unlikely soon to catch up with or to overtake virgin material processing technology. And recycling technology does not now yield products competitive on a cost basis with virgin resources.

If we wish to bring about recycling—and there is no question in my mind that we should wish to do so—incentives must be created or, to put it bluntly, recycling must be subsidized for whatever period is needed to wean the Nation from a nearly exclusive reliance on virgin resources. Part of our national surplus must be allocated to bring about a change in our materials-use patterns.

Because the institution of incentives is essentially a political rather than technical job, any attempt to predict whether or not incentive programs will be instituted and, if yes, how soon, is a speculative endeavor. EPA's incentive studies program, however, will be discussed and should give some indication of directions.

Recycling and Solid Waste Management. Thus far, I have said little about the interaction between solid waste management and recycling. The two subjects, in my opinion, are only

tentatively related. Almost none of the recycled materials tonnage used today comes from solid waste. Once a product is in the waste can, it is almost certainly destined for disposal. All those commodities sought by industry are presegregated from waste, rerouted from the solid waste system, as it were, bypassing or avoiding it.

If recycling should become a new alternative to solid waste disposal, it will also be a new type of recycling activity—not an extension of current recycling practices. Proponents of solid waste recycling should clearly understand that they advocate the formation of new enterprises, new ways of materials-handling, with all attendant uncertainties, risks, and barriers. Some people act as if the recycling of mixed wastes was a promising solution that had somehow been overlooked, but now that we have hit upon this idea, all is well. Quite the contrary is true.

Keeping in mind my assertion that increased resource recovery will depend on new incentives, consider for a moment what might happen if incentives were actually in place and were of such a nature to cause strong industrial demand for a variety of waste commodities. One of the most likely consequences would be an intensification of waste collection, commodity by commodity, by the secondary materials industry, by private voluntary organizations, and by municipalities, *before* these commodities are thrown into the waste stream. We would, in other words, see a considerable amount of ***diversion*** of waste from the conventional solid waste channel. This would occur at the initiative of a variety of groups who would stand to benefit from recycling as a consequence of the incentive system used. Household waste segregation is a probable consequence of incentives. Schools, Scouts, such organizations as the Salvation Army and the Goodwill Industries, municipal public works departments, voluntary organizations, and secondary materials dealers would all be motivated to convince the housewife to separate fractions of the waste stream that are more conveniently and cheaply recycled if received in separate form.

The quantity of waste generated as mixed waste would decrease, and the waste discarded would be those portions least likely to find markets—contaminated paper, small rubber

products, plastics, wood, garbage, yard wastes, ashes, synthetic textiles, and dirt. To recycle these wastes as *materials* commodities will be even more difficult than the recycling of today's waste stream which has not been "picked over," as it were. But recycling of this type of waste as *energy* might be attractive, especially since the removal of metals and glass will result in an increase in the heat value of the incoming waste stream.

To underline this point, let me reformulate it: recycling will

be brought about by incentives. Incentives are likely to cause diversion of saleable materials from the waste stream. The discarded residue is likely to be recoverable only as energy or a fuel. In the long run, the impact of a successful national recycling program on waste management is thus most likely to be a reduction in waste discards and the possibility of using residual wastes as a source of energy.

The Prospects for Recycling

General Program Directions. What are the elements of a national recycling program and what is the probable EPA role in this program? A national program must result in appropriate incentives to use waste materials in an environmentally desirable way. This requirement sounds innocent enough, but its implications are vast and mean radical transformations in our ways of doing business. This becomes clear when you consider *where* the wastes must go and the potential resistance to their acceptance.

Organic wastes—sewage sludges, animal wastes, crop wastes, and food wastes—and high-nutrient mineral wastes must be returned to the soil, implying the displacement of synthetic soil nutrients.

Metals must be returned to the industries that generate them, implying the displacement of ores and associated raw materials.

Materials made of natural fibers—wood, paper, paperboard, and some textiles—can be returned to their originating industries, implying the displacement of pulp wood, sheep's wool, cotton, and so forth. These and synthetic materials like synthetic textiles, plastics, and rubber can be converted directly to energy or into fuels—displacing fossil fuels.

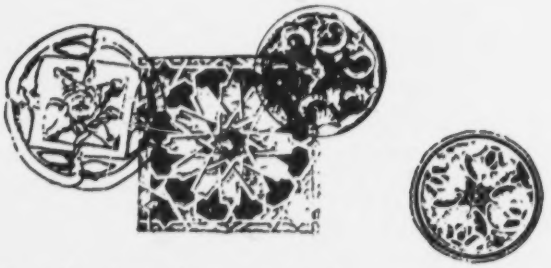
Glass, ceramics, ashes, mine wastes, and similar minerals must move into construction materials; they must compete in an industry traditional in its structure and practices. Glass, of course, can be directly recycled.

This recital should be enough to indicate that an incentive system that produced the desired result would be complex and require years of persuasion and tinkering to bring about.

The implementation is itself likely to take many forms: tax credits to waste users, taxes on virgin materials, Federal purchase specifications, changes in transportation rates, regulation of international trade, and so forth.

Incentives, once in effect, will require time to take hold: facilities need to be modified, waste acquisition systems must be developed, some research and developmnt must be accomplished. Thus we are dealing here with relatively long time frames, at least in terms of total impact on the materials-use patterns of the United States. In some areas, for instance in paper recovery, various pressures—especially Federal, State, and institutional purchasing policies—are very likely to lead to results fairly soon.

Because the reorientation of materials-use patterns will not be painless economically, success of a national recycling program will depend to a very significant extent on popular support of environmental initiatives at all levels in the society. I am convinced that such support is there and that it will grow. If this support is strong, we shall achieve the objectives rapidly; if it is weak, the result will be mixed—a few selective incentive programs, a scattering of resource recovery plants, and a few thousand voluntary recycling center operations that operate on the fringes of the real materials economy, which will



still be heavily dependent on virgin resources and headed toward extinction. "You pays your money and takes your choice."

The EPA Program. What is EPA doing about recycling? Narrowly viewed, EPA's job is spelled out in the Resource Recovery Act of 1970, which directs the Agency, *first,* to study and report to the President and Congress ways and means to bring about greater resource recovery, including the investigation of a variety of incentives and disincentives and, *second,* to demonstrate large-scale recovery of municipal and urban wastes by support of the design, engineering, construction, and one year's operation of such facilities. The EPA operation in this area closely follows the Congressional mandate. The work is divided into a resource recovery studies program and a demonstration program within the Resource Recovery Division of EPA's Office of Solid Waste Management Programs.

The nature of the resource recovery studies we are conducting should be fairly clear from the earlier discussion. In brief, we are examining a variety of incentive options to evaluate their possible effectiveness and impacts; we are also developing the background information on current recycling markets, economics, technology, and practices necessary to give a balanced view of the subject.

Our demonstration program will be launched next week. In light of my comments about the costs of resource recovery technology and the weak market demand for the potential products from such facilities, you can appreciate the fact that we are starting this program with some sense of anxiety.

Man should learn something from experience. The nearest analogy to resource-recovery facility construction programs is the experience with compost plants. In the United States, compost plants have had a history of failure, and the chief weak-

ness of compost plants has been the absence of market demand for the humus product.

Now we are concerned that resource recovery demonstrations may chalk up an equally dismal record unless the greatest vigilance is practiced in the selection of locations, technologies, and organizational deployment composing each demonstration.

In order to keep the risks to a minimum, we developed a set of requirements and criteria that, if adhered to, should result in economically healthy resource recovery facilities. Some of these are as follows:

- The minimum plant size for systems receiving municipal waste must be 150 tons per day.
- At least 60 percent by dry weight of incoming waste must be converted into saleable products, fuels, or energy.
- No more than 25 percent of the plant output may be agricultural/horticultural products.
- Purchase commitments for at least half the plant's output must be obtained in advance, consisting of purchase contracts or letters of intent to buy.
- The net costs of the facility must compare favorably with alternative disposal modes either as currently experienced or as projected five years hence.

There are more requirements, of course, but this selection shows that we are entering upon this program with more than usual advance programming.

We do not believe that demonstration programs are a substitute for incentive programs. Without new incentives, demonstrations may not attract any imitators. Given our criteria, it will be difficult to justify a resource recovery plant unless it is very large, thus taking advantage of economies of scale, is in an area where disposal costs as currently experienced are already high, and is in an area accessible to markets for the output waste commodities.

Given today's conditions, in other words, resource recovery facilities are unlikely to be built in many locations, and even where they are built, they are likely merely to cause a shift in the *source* of wastes for the manufacturers rather than an

increase in demand. If the demand in an area is for 1,000 tons a month of newspapers, it will not increase just because a resource recovery facility is built. What is likely to happen is that instead of getting the newspaper from paper drives conducted by local schools, the manufacturer will get it from the recovery facility.

The demonstration program is important as one of several building blocks in a total program. We are still at a point in the development of resource recovery where all conceivable initiatives—from Girl Scout can collections all the way to the deliberation of the National Commission on Materials Policy—must be supported and fostered.

EPA's interest in resource recovery may also be viewed in the broader context of the Agency's overall mission to protect the environment. Here suffice it to say that recycling has been shown to be environmentally beneficial in all instances studied in detail. The recycling concept thus contributes to several EPA missions in addition to the Agency's solid waste management mission.

Conclusions

Recycling today is declining in importance in the market even as interest in resource recovery is rapidly increasing. Resource recovery is not viewed as a particularly attractive solution to the solid waste problem in the short term, except possibly the recovery of energy from mixed combustible wastes. In the long run, resource recovery will become a necessary part of our materials-use practices; this will be brought about by the creation of new incentives.

Presented by Mr. Darnay, in March 1972, to a seminar sponsored by the Urban Drainage and Flood Control District and the Denver Regional Council of Governments, Denver, Colorado. Mr. Darnay is Director, Resource Recovery Division, Office of Solid Waste Management Programs, U.S. Environmental Protection Agency.